

Increasing Fruit and Vegetable Consumption Through Worksites and Families in the Treatwell 5-a-Day Study

ABSTRACT

Objectives. We report on the results of the Treatwell 5-a-Day study, a worksite intervention aimed at increasing consumption of fruits and vegetables.

Methods. Twenty-two worksites were randomly assigned to 3 groups: (1) a minimal intervention control group, (2) a worksite intervention, and (3) a worksite-plus-family intervention. The interventions used community-organizing strategies and were structured to target multiple levels of influence, following a socioecological model. Data were collected by self-administered employee surveys before and after the intervention; the response rate was 87% (n = 1359) at baseline and 76% (n = 1306) at follow-up. A process tracking system was used to document intervention delivery.

Results. After control for worksite, gender, education, occupation, race/ethnicity, and living situation, total fruit and vegetable intake increased by 19% in the worksite-plus-family group, 7% in the worksite intervention group, and 0% in the control group ($P = .05$). These changes reflect a one half serving increase among workers in the worksite-plus-family group compared with the control group ($P = .018$).

Conclusions. The worksite-plus-family intervention was more successful in increasing fruit and vegetable consumption than was the worksite intervention. Worksite interventions involving family members appear to be a promising strategy for influencing workers' dietary habits. (*Am J Public Health*. 1999;89:54-60)

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Diet has been estimated to contribute to approximately 35% of all cancer incidence.¹⁻⁴ Consistent evidence points to the protective role played by consumption of fruits and vegetables in a large number of epithelial cancers.⁵⁻⁷ In more than 200 case-control or cohort studies, persons consuming higher amounts of vegetables and fruits or having higher blood levels of carotenoid were less prone to develop various cancers.⁷ Recent evidence indicates that only 20% to 30% of Americans meet recommendations to consume 5 or more servings of fruits and vegetables per day.⁸⁻¹⁴

In response to this discrepancy, the National Cancer Institute launched its 5-a-Day for Better Health campaign.^{15,16} This initiative included 9 research studies targeting both adults and children in a range of settings, one being the worksite. The present study reports the results of the Treatwell 5-a-Day study, 1 of 3 worksite-based nutrition intervention studies included in the 5-a-Day for Better Health campaign. This study was designed to assess the effectiveness of a worksite-based nutrition intervention involving families in promoting increased consumption of fruits and vegetables.¹⁷ This is one of the first studies to assess the impact of incorporating education for families into a worksite-based health promotion program.¹⁷

For several reasons, worksites are an ideal channel for promoting change in large segments of the population. First, nearly 70% of US adults between 18 and 65 years of age are employed.¹⁸ Second, interventions in worksites can be offered repeatedly, thus increasing the likelihood of motivating behavior change in persons who are at various stages of readiness. Third, worksite-based interventions permit support for individual behavior change attempts by modifying the environment and social norms.¹⁹ Finally, worksites provide access to

large numbers of persons, many of whom may not be reached through other intervention channels.²⁰ This high contact rate, coupled with even a small intervention effect, has the potential to produce substantial changes in dietary habits and activity behavior in the US population.²¹

Worksites are an increasingly common channel for promoting healthy eating behavior change in large segments of the population.²² Nationally, the proportion of worksites offering nutrition education as part of health promotion programs increased from 17% in 1985²³ to 32% in 1992.²⁴ However, very few randomized studies have reported the effectiveness of worksite-based nutrition education programs. A recent review reported that only 4 randomized studies assessing the effects of worksite nutrition education programs have been published since 1980, and in only 1 of these studies²⁵ was the worksite the unit of analysis.²⁶ Using the worksite as the unit of analysis is necessary in worksite-based interventions that take advantage of the worksite environment and structures, since individual behavior change is embedded in worksite-level changes.

In addition to the influence of the worksite, social norms and eating patterns at

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home may contribute substantially to an individual's eating habits.²⁷ For example, barriers to healthy eating posed by family preferences for fruits and vegetables have been found to be associated with individual consumption of fruits and vegetables.^{28,29} Similarly, spousal support has been related to weight loss and adherence to low-fat, low-cholesterol diets.³⁰ Modeling of healthy behaviors and the family's social norms have also been found to influence health behaviors.³¹⁻³⁶ Few prior worksite cancer control studies have assessed the impact of family support on worker health behaviors.^{26,37} Family-focused interventions have been evaluated by some studies targeting the health behaviors of children and youth, with some positive results. A focus on the family is likely to be attractive to employers, given concerns about the cost of health care for both workers and dependents.³⁸

This study incorporated several theoretical perspectives. Treatwell 5-a-Day relied on community organization strategies for ensuring worker participation in the design and implementation of the intervention. Treatwell 5-a-Day was also based on a socioecological model that recognizes that individual behaviors respond to multiple levels of influence, including intrapersonal factors, interpersonal processes, organizational structures, and community norms.³⁹⁻⁴² In this way, the intervention aimed to build support for behavior change from coworkers, household members, and the worksite environment.

Methods

The Treatwell 5-a-Day study assessed the effectiveness of 2 worksite approaches to promoting workers' increased consumption of fruits and vegetables, one focusing exclusively on the worksite and a second adding a family-based intervention. Twenty-two worksites were randomly assigned to 3 groups: (1) a minimal intervention control group (8 sites), (2) a worksite intervention (7 sites), and (3) a worksite-plus-family intervention (7 sites). A randomized, controlled research design was used, with the worksite as the unit of assignment and intervention. Following completion of a baseline survey, worksites were stratified into blocks based on size and ethnic composition and randomized by block to achieve balance in size and ethnicity across conditions.

The Setting

Treatwell 5-a-Day was conducted in 22 community health centers. These health centers are located in underserved areas, often

ethnically and racially diverse communities, and provide services to low-income residents. Staff often are hired from the surrounding community and are generally racially and ethnically diverse groups. The 22 community health centers recruited to this study were located in eastern Massachusetts; 17 of the 22 sites were in the greater Boston metropolitan area. At baseline, each of these worksites employed between 27 and 640 workers; 20 of the 22 sites employed fewer than 120 workers.

The Treatwell 5-a-Day Intervention

The Treatwell 5-a-Day intervention design allowed for the testing of the addition of program components to the basic model, following standardized intervention protocols for each condition. Each of the 3 intervention groups had overlapping components. All 3 groups received the core intervention provided to the minimal intervention control group. The worksite intervention provided to the worksite intervention group was also provided to the worksite-plus-family intervention group. In addition, the worksite-plus-family intervention group received a family-focused intervention. For each intervention activity, measurable process objectives were specified and were monitored through a process tracking system. The intervention model has been described previously¹⁷ and is summarized below. The intervention was conducted between mid-September 1994 and April 30, 1996, a period of 19.5 months.

All intervention conditions. The core intervention offered across all 3 intervention conditions included periodic exposure to the national 5-a-Day media campaigns, promotion of the Cancer Information Service Hot Line, and a 1-hour general nutrition presentation and taste test provided at the worksites to ensure the cooperation of all worksites throughout the study period.

Worksite and worksite-plus-family intervention conditions. In addition to the interventions described for all intervention conditions, 3 core elements were provided to the worksite intervention and worksite-plus-family intervention groups: (1) worker participation in program planning and implementation, (2) programs aimed at individual behavior change, and (3) programs aimed at changes in the worksite environment. Because information on fruits and vegetables was presented within the context of the total diet, the intervention focused secondarily on decreased fat consumption and increased fiber consumption.

Worker participation in program planning and implementation was obtained through a worksite coordinator and an

employee advisory board. The worksite coordinator served as the primary contact between the project and the community health centers. The advisory board provided direction for nutrition education efforts, fostered worker ownership of programs, provided feedback to project staff, tailored programs to the needs and interests of each worksite, assisted in program implementation, and helped tailor the program to meet the needs of the ethnic groups represented at their community health center.

The core interventions aimed at individual behavior change included (1) a kickoff event, including festive activities designed to raise program awareness and provide educational opportunities; (2) the Eatwell 5-a-Day discussion series, which consisted of ten 30-minute sessions that provided information that employees needed to purchase and prepare healthful meals; and (3) at least 1 educational campaign each intervention year, which was an orchestrated set of nutrition education activities arranged around a theme that lasted for 3 to 5 weeks. Employee advisory boards initiated other educational activities as appropriate for their particular health centers. Other educational activities initiated by the community health centers included holiday events. For example, in the worksite condition, advisory board members staged a Halloween pumpkin-decorating contest between departments, accompanied by pumpkin recipes and the distribution of educational materials with the 5-a-Day message. In the worksite-plus-family condition, children of health center staff contributed illustrated recipes of foods containing fruits and vegetables, which were compiled into a cookbook.

Environmental changes were implemented along with direct education to build a motivational climate for initiating and maintaining changes.^{43,44} Consultation was provided to encourage community health centers to increase their offerings of fruits and vegetables in vending machines, at special-occasion meals and snacks, and in break rooms.^{45,46} In addition, interventions were offered to stimulate and support individual behavior change through environmental interventions such as point-of-choice labeling of fruits and vegetables and posters, videos, and brochures placed where employees eat.

Worksite-plus-family intervention condition. In addition to the components offered in the worksite intervention group, the worksite-plus-family condition received (1) a written learn-at-home program, "Fit in 5," which was a 5-part series distributed through the worksite and then returned to the intervention team, who documented its completion and provided comments and incentives to participants; (2) an annual family newsletter; (3) an

annual family festival, which was incorporated into established community health center events such as family holiday parties and picnics; and (4) periodic mailings of materials to families (9 mailings over the course of the 19.5-month intervention). In addition, employee advisory boards in this condition were encouraged to identify other family-focused interventions appropriate for their health centers. Materials and programs were directed to families in their many forms, such as to families with adults only, families with children, single-parent families, and families with two or more adults. The family-focused interventions were designed to create a home environment supportive of the workers' attempts to change eating patterns, while also encouraging family members to increase consumption of fruits and vegetables.

Data Collection Methods

At baseline, the 22 community health centers employed approximately 2800 workers. The survey was administered prior to the beginning of the intervention—between May and August 1994—to a census of eligible workers in 20 sites each employing 120 or fewer workers and to a random sample of 100 employees in the 2 largest sites, which employed 350 and 600 workers. The self-administered survey was distributed to 1588 eligible employees (permanent employees working at least 15 hours per week). The mean worksite response rate was 87% (range, 68%–100%; $n = 1359$). The follow-up survey, conducted at the conclusion of the intervention (May–July 1996), used the same sampling techniques as at baseline and resulted in a mean worksite response rate of 76% (range, 56%–100%; $n = 1306$). The 2 samples were independently selected at the 2 time points; about half (47%) of the respondents at baseline also responded at follow-up.

Measures. Measures used in these analyses included fruit and vegetable intake, reported coworker and household support, and worker characteristics.

Fruit and vegetable intake. Intake was measured with a 7-item screener. This screener was developed for use in the National Cancer Institute's 9 Five-a-Day for Better Health research projects, based on the national 5-a-Day survey¹⁶ and other fruit and vegetable screeners.^{13,47,48} The 7 items assessed the frequency and number of servings of orange or grapefruit juice; other fruit juices; green salad; french fries or fried potatoes; baked, boiled, or mashed potatoes; vegetables other than salad or potatoes; and fruit, not counting juices. Additional dietary data, not presented here, were collected by means of the Food Frequency Questionnaire.⁴⁹

which assessed changes in total diet targeted as secondary outcomes of the study (fat and dietary fiber), and a single-item measure of fruit and vegetable consumption.

Coworker support for healthy eating. Coworker support was assessed according to 6 items, each measured on a 4-point scale (never, seldom, sometimes, often). Respondents were asked how often their coworkers "compliment your attempts to eat a healthy diet," "encourage you to eat vegetables," "encourage you to eat fruit," "bring healthy foods to work for you to try," "bring fruit to work for you to try," and "bring vegetables to work for you to try." We combined the items by summing the responses so that a low score reflected low perceived coworker support and a high score reflected high perceived support. The resulting score ranged from 1 (never received any of the support items) to 19 (often received support). The Cronbach α for the coworker support variable was .83.

Household support for healthy eating. Household support was assessed for those respondents who reported not living alone, by means of 6 items corresponding to those used to assess coworker support. Respondents were asked how often a member of their household "compliments your attempts to eat a healthy diet," "encourages you to eat vegetables," "encourages you to eat fruit," "brings healthy foods home for you to try," "brings fruit home for you to try," and "brings vegetables home for you to try." Again, we formed a composite variable by summing the responses to these items such that a low score indicated low household support. The summary score ranged from 1 to 19. The Cronbach α for the household support variable was .90.

Worker characteristics. Worker characteristics, assessed by means of standard items, included gender, age, race/ethnicity, education, and income. Job categories were based on usual occupational categories in the community health centers. Living situation was assessed as living alone vs living with a spouse, partner, other adults, or children.

Data Analysis

The unit of randomization and intervention was the worksite, while the unit of measurement was the employee. All analyses were computed by taking into consideration the nesting of employees in worksites. We used mixed-effects linear modeling to test hypotheses about intervention groups, controlling for the clustering of respondents in worksites. All analyses were conducted with the personal computer version of SAS statistical software.⁵⁰

We compared the 3 intervention groups with regard to baseline characteristics to

evaluate the effectiveness of randomization in producing comparable groups. For categorical characteristics such as gender and race, we estimated the generalized linear mixed model by using the iterative reweighted maximum likelihood method, with intervention group as a fixed effect and worksite as a random effect. For continuous measures such as servings of fruit and vegetables, we used mixed model analysis of variance.

To test whether the 3 treatment conditions differed significantly regarding increase in servings of fruits and vegetables, we used mixed model analysis of variance and covariance. Intervention group and time of survey (baseline or final) were included as fixed effects, while worksite was included as a random effect. We tested the interaction of intervention by time to determine whether the difference between baseline and final values was equal across intervention groups. We computed the ratio of the mean square of the interaction effect to mean square error and compared it to an F distribution with appropriate *df*. If a significant intervention effect was found ($P < .05$), individual comparisons of each intervention to the control condition were computed.

Prior to hypothesis testing, the distributions of the continuous measures were evaluated for departures from normality. The distribution of servings of fruits and vegetables was highly skewed, so we converted to a logarithmic scale (base *e*) for analysis. Mean values were computed back to servings per day for reporting purposes (geometric mean). Since transforming the results back from log servings of fruits and vegetables yields a percentage of change rather than a difference, results are presented as a percentage of change.

Results

In this study, with 22 worksites in 3 study conditions and an average of 54 participants per worksite per time, there was 74% power to detect the observed differences among the 3 conditions at the 5% significance level, without controlling for covariates. When significant covariates were controlled, the sample size was reduced to an average of 48 participants per worksite, but the power increased slightly to 75% owing to a reduction in the mean square error and an increase in the effects.

Characteristics of the Sample

Table 1 compares respondents to the 2 surveys regarding demographic characteristics. Both samples were 84% women and

included 23% Latino and 18% non-Latino Black respondents. Both samples were generally well educated, with approximately 80% having at least some post-high school training; the occupational distribution reflected this trend. About 15% lived alone.

There were no statistically significant differences among the 3 intervention groups at baseline, although the worksite intervention group had a slightly higher percentage of men and a higher percentage with at least a baccalaureate education, as shown in Table 2. There were no meaningful differences in household support, coworker support, or usual intake of fruit and vegetables.

Coworker and Household Support

Neither intervention condition had an effect on reported household support among workers who did not live alone, as shown in Table 3. There was, however, a significant intervention effect on reported coworker support.

Change in Consumption of Fruits and Vegetables

Table 4 presents the geometric mean and percentage of change in servings of fruits and vegetables for each of the 3 groups at each time point, using 4 different models. In all 4 models, the correlation of workers within worksites was 0; worksite was retained in the analyses because it was the unit of assignment. In model 0, means are controlled only for the clustering of employees in worksites. In model 1, the analysis is restricted to subjects with complete information on the covariates of interest. Demographic characteristics were included as covariates if they were significantly associated with fruit and vegetable consumption. Model 2 shows the means adjusted for gender, education, occupation, race/ethnicity and living situation, in addition to worksite. Finally, in model 3, means and percentages of change are controlled for the same covariates as are included in model 2, as well as for coworker support.

When sociodemographic characteristics are controlled (model 2), workers in the worksite intervention reported a 7% increase (approximately 0.2 servings), while those in the worksite-plus-family condition reported a 19% increase (approximately 0.5 servings). The overall difference among the intervention groups is statistically significant ($P = .05$). The increase in the worksite-plus-family group is significantly greater than that in the control group ($P = .02$), while the difference between the worksite intervention group and the control group is not statisti-

TABLE 1—Demographic Characteristics of Participants in the Treatwell 5-a-Day Study

Characteristic	Baseline		Final	
	n	%	n	%
Gender				
Female	1096	83.8	1088	84.1
Male	212	16.2	206	15.9
Occupation				
Skill, service, clerical	417	31.5	375	29.2
Paraprofessional, technical	263	19.8	259	20.2
Professional	471	35.5	465	36.2
Manager	174	13.1	184	14.3
Education				
12th grade or less	269	21.1	253	19.8
Some college, vocational school	434	34.1	455	35.5
Baccalaureate	225	17.7	220	17.2
Postbaccalaureate work	346	27.2	352	27.5
Living situation				
Lives alone	202	15.3	187	14.7
Lives with others	1121	84.7	1089	85.3
Race/ethnicity				
Hispanic	300	22.5	295	23.0
Black	238	17.9	226	17.6
White, other	793	59.6	761	59.4

cally significant ($P = .47$). Gender, education, occupation, and living situation were significantly associated with fruit and vegetable consumption but not with the level of change or with differences between intervention conditions.

Because we found a significant increase in coworker support in the 2 intervention conditions, as shown in Table 3, we wanted to examine the extent to which the intervention effect in servings of fruit and vegetables could be accounted for by this increased coworker support. When coworker support was added to the model, the percentage of change in servings of fruits and vegetables decreased, as shown in model 3. When the percentages of change as estimated by the

analyses with and without coworker support are compared, it is clear that coworker support does explain some of the intervention effect. Nevertheless, especially in the worksite-plus-family condition, there remains a statistically significant increase in fruit and vegetable consumption even when the effect of coworker support is accounted for.

Discussion

In response to mounting evidence about the protective role of fruit and vegetable consumption for cancer as well as other diseases,¹⁻⁴ a growing number of interventions are being tested with the aim of increasing

TABLE 2—Effectiveness of Randomization in the Treatwell 5-a-Day Study (Baseline Data)

	Worksite-Plus-Family Intervention	Worksite Intervention	Minimal Intervention Control	P
Male, %	14.6	19.8	14.3	.25
White, %	54.2	47.4	58.0	.83
Hispanic, %	18.3	20.1	13.5	.75
Baccalaureate or above, %	42.6	50.9	42.1	.06
Professional, %	35.4	36.0	35.6	.99
Living alone, %	13.4	16.9	14.3	.53
Household support, ^a mean ^b	9.8	10.3	9.9	.71
Coworker support, mean ^b	7.9	7.5	7.2	.24
Servings of fruits and vegetables, geometric mean	2.8	3.0	2.9	.62

^aAmong participants not living alone.

^bHousehold and coworker support were each measured by 6 items using a 4-point scale, with a range from 1 (never received any of the support items) to 19 (often received the support items).

intake of these foods. The National Cancer Institute's 5-a-Day for Better Health initiative included 9 research studies targeting both adults and children in a range of settings. The study presented here was 1 of 3 studies to test a worksite-based intervention promoting fruit and vegetable consumption and was the only worksite study to include a family component.

In this study, we found that a worksite-plus-family intervention was more successful in increasing fruit and vegetable consumption than was an intervention focusing exclusively on the worksite. Controlling for gender, education, occupation, living situation, and worksite, we observed that workers in the worksite-plus-family group increased fruit and vegetable consumption by 19%, compared with no change in the control group ($P = .018$), reflecting a difference of one half serving; we observed a 7% increase in the worksite intervention group. Changes of this magnitude are likely to have meaningful benefits at the population level, given that public health interventions such as these must be interpreted in terms of both their efficacy in producing individual behavior change and their reach within the population.⁵¹⁻⁵⁴ These results also compare favorably to prior worksite health promotion intervention trials that have targeted nutrition. According to a review by Glanz and colleagues,²⁶ only 4 randomized studies of worksite nutrition education programs were published between 1980 and 1995, and only 1 of those studies used the worksite as the unit of randomization and analysis. Although that study aimed to reduce fat consumption and increase fiber consumption,^{25,55} the investigators also reported results for other dietary outcomes; it found no difference between intervention and control sites in fruit consumption, although consumption of vegetables increased, on average, 4.9 servings more *per month* in intervention worksites than in control sites, translating into a daily difference of 0.16 servings.⁵⁶ The Working Well Trial, which targeted fruit and vegetable consumption, dietary fat, and smoking cessation, found an increase of 0.19 servings per day in fruit and vegetable consumption.⁵⁷ Results of other studies, including other 5-a-Day worksite intervention studies, are not yet available.

Most studies that have looked at the role of the family in health behavior change have focused on children rather than adults, and much of the work has been atheoretical or cross-sectional in nature.⁵⁸ At least 3 community-based intervention studies have included a family intervention component. Crockett et al.³¹ compared a classroom-based nutrition intervention, Hearty Heart and Friends, with a similar condition that included a family

TABLE 3—Coworker and Household Support for Healthy Eating: Adjusted Mean Values at Baseline and Final, Controlling for Worksite in the Treatwell 5-a-Day Study

	Worksite and Family	Worksite Only	Control	P^a
Household support				
Baseline		10.3	10.0	
Final	10.8	11.0	11.1	
Change	0.9	0.7	1.1	.72
Coworker support				
Baseline	7.9	7.5	7.2	
Final	9.6	9.9	8.4	
Change	1.7	2.4	1.2	.009

Note. Coworker and household support were each measured by 6 items using a 4-point scale, with a range from 1 (never received any of the support items) to 19 (often received the support items).

^a P values for test that the mean change is equal across conditions.

intervention, the Hearty Heart Home Team. Compared with the families assigned to the classroom intervention, significant improvements were found among Home Team families in knowledge about diet and heart disease, efficacy, intention, outcome expectations, modeling of healthy food choices, parent-child communication, and child involvement in food-related issues in the home. Important reductions were also found among Home Team participants in children's fat intake and percentage of calories from both saturated and unsaturated fats.⁵⁹ The recent CATCH trial built on the success of the Home Team intervention, extending the family intervention to physical activity, tobacco use, and nutrition; the school-based intervention was compared with a school-plus-family condition and a control condition. The study found that greater improvement in knowledge and attitudes related to diet and physical activity.^{60,61} A third trial, the San Diego Family Health Project,⁶² was an intensive, community-based intervention with low- to middle-income Mexican American and Anglo American families; it focused on diet and physical activity. Improvements in both dietary knowledge and diets were observed among intervention families, and this intervention effect was maintained at 1-year follow-up. These studies point to the potential importance of the inclusion of the family in interventions targeting dietary patterns and physical activity, as further underlined by the results reported here.

The greater effectiveness of the worksite-plus-family intervention relative to the other 2 conditions may be due to several factors. Although the measure of household support used here was not significantly related to intervention effectiveness, this previously untested measure of household support could have failed to capture important elements of support for healthy eating. In addition, the intervention effectiveness may

have been improved by addressing broader social contexts influencing dietary patterns, beyond those residing only at work.

On the basis of these results, we conclude that a worksite intervention that extends to the workers' families may address household barriers to fruit and vegetable consumption and provide resources not assessed through household support measures. Thus, this study provides promising results about the potential efficacy of involving families in worksite-based behavior change interventions. The results of this study support the underlying assumption that dietary habits occur in a social context, and they demonstrate that the effectiveness of nutritional interventions can be enhanced when they take into account an individual's social context, including that at home and at the worksite. Nonetheless, further study is needed to understand more fully the role of household support in dietary change among adults and the characteristics of household support most likely to contribute to dietary change.

The selection of the community health centers as worksites in this study offers several advantages. First, evaluation of health promotion programs implemented in these public sector worksites represents an important new initiative for worksite intervention research. Although approximately 15% of the American labor force works in government, few health promotion programs have been evaluated in these worksites.⁶³ Second, such worksites were generally small; most employed fewer than 120 persons. Although an increasing number of worksites offer health promotion programming, such activities are least common in small worksites.⁶⁴ Small worksites are an especially important target, since they employ females, Latinos, and those with low levels of education in greater proportions than do larger businesses.⁶³ Despite these advantages, the inclusion of community health centers poses

several limitations in interpreting the results of this study. It is likely that people in this sample, compared with other workers, are more knowledgeable about, more interested in, and more motivated to change their health-related behaviors. In addition, coworker support for dietary change may be stronger in this setting.

Several additional caveats must be considered in interpreting these results. There is some possibility of reporting bias within the context of a behavioral intervention. Conceivably, those persons receiving the intervention may have reported higher consumption of fruits and vegetables because of the social desirability of such a response or because they were more knowledgeable about serving sizes used in reporting consumption. The use of a self-administered questionnaire such as the one used here reduces the potential for social desirability bias relative to interviewer-administered surveys. In addition, there is no reason to assume that these potential sources of bias would differ between the 2 intervention groups, between which a sizable difference in servings of fruits and vegetables was reported. An additional caveat is that the measures used to assess coworker and household support were not previously validated and may not have captured all components of support.

Despite these limitations, these results suggest that a worksite intervention that includes a family focus may offer a new direction for worksite interventions and holds promise as a strategy for improving intervention effectiveness. The worksite-plus-family intervention was more successful in increasing fruit and vegetable consumption than was the worksite intervention, and it increased consumption of fruits and vegetables by one half serving over that observed in the control group. Recent reports⁵¹ (also G. Colditz, unpublished data, 1998) suggest that this magnitude of change may be both efficacious and cost-effective when implemented on a population level. Social systems, including family members and coworkers, have the potential to play an important role in determining the climate of health behavior and can assist in influencing health behaviors such as eating habits. □

Contributors

Dr Sorensen was the principal investigator for the study and took the lead in planning the study reported here. Dr Stoddard led the data analysis and interpretation. Dr Cohen contributed intervention expertise. Dr Peterson contributed to the analytic plan. Ms Hunt contributed intervention expertise and edited the discussion section. Ms Palombo commented on later drafts. Ms Stein contributed to the description of the study population and to the discussion of the

TABLE 4—Adjusted^a Mean Servings of Fruits and Vegetables (7-Item Screener) at Baseline and Final Surveys by Intervention Condition, Controlling for 4 Sets of Covariates in the Treatwell 5-a-Day Study

Intervention	Model 0 (n = 2382)	Model 1 ^b (n = 2123)	Model 2 ^b (n = 2123)	Model 3 ^b (n = 2123)
Worksite-plus-family intervention				
Baseline, mean	2.84	2.80	2.53	2.55
Final, mean	3.24	3.29	3.02	2.96
Change, %	14	17	19	16
Worksite intervention				
Baseline, mean	2.95	3.04	2.69	2.73
Final, mean	3.28	3.33	2.89	2.81
Change, %	11	10	7	3
Minimal intervention control				
Baseline, mean	2.90	2.92	2.61	2.66
Final, mean	2.91	2.92	2.62	2.62
Change, %	1	0.2	0.4	-2
P ^c	.17	.10	.05	.05

^aGeometric means are adjusted for the following covariates in each model: model 0: worksite (sample size not restricted); model 1: worksite (sample size restricted); model 2: worksite, gender, education, occupation, race/ethnicity, and living situation; model 3: worksite, gender, education, occupation, race/ethnicity, living situation, and coworker support.

^bCases in models 1, 2, and 3 are restricted to no missing values for gender, education, occupation, race/ethnicity, living situation, and coworker support.

^cP value is for test that percentage of change is equal across conditions.

implementation of the intervention. Ms Lederman coordinated data collection and management. All authors codeveloped the intellectual content, contributed to multiple drafts, and are guarantors for the integrity of the article as a whole.

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